US009185732B1

(12) **United States Patent**
Saund et al.

(10) **Patent No.: US 9,185,732 B1**
(45) **Date of Patent: *Nov. 10, 2015**

(54) **BEACON BASED PROXIMITY SERVICES**

(71) Applicant: **PICO Mobile Networks, Inc.**, Sunnyvale, CA (US)

(72) Inventors: **Saran Saund**, Mountain View, CA (US); **Paul A. Lambert**, Mountain View, CA (US)

(73) Assignee: **PICO MOBILE NETWORKS, INC.**, Sunnyvale, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 246 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/850,875**

(22) Filed: **Mar. 26, 2013**

Related U.S. Application Data

(63) Continuation of application No. 11/542,394, filed on Oct. 3, 2006, now Pat. No. 8,411,662.

(60) Provisional application No. 60/723,299, filed on Oct. 4, 2005.

(51) **Int. Cl.**
H04J 3/00 (2006.01)
H04W 76/02 (2009.01)

(52) **U.S. Cl.**
CPC ***H04W 76/021*** (2013.01)

(58) **Field of Classification Search**
CPC H04J 3/00
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,735,583	A	4/1998	Katayama et al.	
5,738,563	A	4/1998	Comas et al.	
5,907,566	A	5/1999	Benson et al.	
6,182,248	B1	1/2001	Armstrong et al.	
6,272,120	B1	8/2001	Alexander	
6,287,200	B1	9/2001	Sharma	
6,397,357	B1	5/2002	Cooper	
6,587,691	B1	7/2003	Granstam et al.	
6,600,726	B1	7/2003	Nevo et al.	
6,690,935	B1	2/2004	Calot et al.	
6,704,866	B1	3/2004	Benayoun et al.	
6,707,801	B2	3/2004	Hsu	
6,760,587	B2	7/2004	Holtzman et al.	
6,785,592	B1	8/2004	Smith et al.	
6,785,892	B1	8/2004	Miller et al.	
6,788,675	B1	9/2004	Yang	
6,793,580	B2	9/2004	Sinclair et al.	
6,795,701	B1	9/2004	Baker et al.	
6,799,056	B2	9/2004	Curley et al.	
6,859,460	B1	2/2005	Chen	
6,879,574	B2	4/2005	Naghian et al.	
6,879,812	B2 *	4/2005	Agrawal et al.	455/67.11
6,909,705	B1	6/2005	Lee et al.	
6,932,698	B2	8/2005	Sprogis	
6,973,580	B1	12/2005	Carroll et al.	
7,013,391	B2	3/2006	Herle et al.	
7,024,199	B1	4/2006	Massie et al.	
7,072,323	B2	7/2006	Roberts et al.	
7,073,129	B1	7/2006	Robarts et al.	
7,085,257	B1	8/2006	Karves et al.	
7,087,562	B2	8/2006	Abe et al.	
7,097,562	B2	8/2006	Gagner	
7,136,642	B1	11/2006	Massie et al.	
7,143,171	B2	11/2006	Eriksson et al.	
7,162,238	B1	1/2007	Massie et al.	
7,181,544	B2	2/2007	Vangal et al.	
7,224,964	B2	5/2007	Souissi et al.	
7,236,772	B1	6/2007	Botzas	
7,251,235	B2	7/2007	Wentink	
7,308,263	B2	12/2007	Gallagher et al.	
7,324,444	B1	1/2008	Liang et al.	
7,400,722	B2	7/2008	Qi et al.	
7,435,179	B1	10/2008	Ford	
7,440,430	B1	10/2008	Jagadeesan et al.	
7,452,278	B2	11/2008	Chen et al.	
7,656,847	B2	2/2010	Mela et al.	
7,710,982	B2	5/2010	Ohmuro et al.	
7,779,334	B2	8/2010	Earle et al.	
7,817,545	B2	10/2010	Ho et al.	
7,881,284	B2	2/2011	Lin et al.	
7,899,017	B2	3/2011	Yu et al.	
7,970,384	B1	6/2011	Lambert et al.	
8,194,600	B2	6/2012	Nagaraja	
8,194,629	B2	6/2012	Agulnik et al.	
8,325,659	B2	12/2012	Chen et al.	
8,374,584	B1	2/2013	Lambert et al.	
8,411,656	B2	4/2013	Liu	
2002/0087370	A1	7/2002	Brueckheimer et al.	
2002/0151366	A1 *	10/2002	Walker et al.	463/42
2002/0152388	A1 *	10/2002	Linnartz et al.	713/176
2002/0157044	A1	10/2002	Byrd	
2002/0169539	A1	11/2002	Menard et al.	
2002/0191560	A1	12/2002	Chen et al.	
2002/0199124	A1	12/2002	Adkisson	
2003/0065805	A1	4/2003	Barnes	
2003/0069018	A1	4/2003	Matta et al.	
2003/0088690	A1	5/2003	Zuckerman et al.	
2003/0115320	A1	6/2003	Yarroll et al.	
2003/0152093	A1	8/2003	Gupta et al.	
2003/0169755	A1	9/2003	Ternovsky	
2003/0182454	A1	9/2003	Huth et al.	
2003/0224855	A1	12/2003	Cunningham	
2003/0231189	A1	12/2003	Williams	
2003/0231625	A1	12/2003	Calvignac et al.	

(Continued)

OTHER PUBLICATIONS

IEEE Standards Board.IEEE 802.11 Standard, 1999. 1999 Edition (R2003).

(Continued)

Primary Examiner — Andrew Lai
Assistant Examiner — Leon Andrews

(57) **ABSTRACT**

A first wireless device including a receiver configured to receive a beacon transmitted by a second wireless device, where the beacon includes a service set identifier, and where the service set identifier is encoded to include a capability of the second wireless device; and a transmitter configured to transmit, to a server, the service set identifier received from the second wireless device, where the service set identifier is decodable by the server to retrieve the capability of the second wireless device from the service set identifier. The receiver is further configured to receive, from the server, the capability of the second wireless device subsequent to the server having decoded the service set identifier.

14 Claims, No Drawings

(56) **References Cited**

U.S. PATENT DOCUMENTS

2003/0235175 A1 12/2003 Naghian et al.
2004/0066751 A1 4/2004 Tseng et al.
2004/0081106 A1 4/2004 Bruhn
2004/0082383 A1 4/2004 Muncaster et al.
2004/0105415 A1 6/2004 Fujiwara et al.
2004/0120309 A1 6/2004 Kurittu et al.
2004/0127277 A1 7/2004 Walker et al.
2004/0174829 A1 9/2004 Ayyagari
2004/0185851 A1 9/2004 Nagai
2004/0196808 A1 10/2004 Chaskar et al.
2004/0203350 A1 10/2004 Shultz et al.
2004/0225932 A1 11/2004 Hoda et al.
2004/0236850 A1 11/2004 Krumm et al.
2004/0243887 A1 12/2004 Sharma et al.
2005/0025163 A1 2/2005 Christie
2005/0032577 A1 2/2005 Blackburn et al.
2005/0041660 A1 2/2005 Pennec et al.
2005/0041793 A1 2/2005 Fulton et al.
2005/0041796 A1 2/2005 Joseph et al.
2005/0058112 A1 3/2005 Lahey et al.
2005/0060547 A1 3/2005 Saito et al.
2005/0073980 A1* 4/2005 Thomson et al. 370/338
2005/0079873 A1 4/2005 Caspi et al.
2005/0099977 A1 5/2005 Williams et al.
2005/0157661 A1 7/2005 Cho
2005/0177369 A1 8/2005 Stoimenov et al.
2005/0177639 A1* 8/2005 Reunamaki et al. 709/227
2005/0181872 A1 8/2005 Acharya et al.
2005/0197189 A1 9/2005 Schultz
2005/0207342 A1 9/2005 Tanabe et al.
2005/0250487 A1* 11/2005 Miwa et al. 455/422.1
2005/0250497 A1 11/2005 Ghosh et al.
2005/0268003 A1* 12/2005 Wang et al. 710/36
2005/0286456 A1* 12/2005 McNew et al. 370/312
2006/0041750 A1* 2/2006 Carter et al. 713/168
2006/0045138 A1 3/2006 Black et al.
2006/0046709 A1 3/2006 Krumm et al.
2006/0063539 A1 3/2006 Beyer
2006/0135262 A1 6/2006 Kennedy et al.
2006/0166740 A1 7/2006 Sufuentes
2006/0172736 A1 8/2006 Nevo
2006/0205409 A1 9/2006 Chiou et al.
2006/0215576 A1 9/2006 Yu et al.
2006/0221857 A1 10/2006 Bushnell et al.
2006/0268711 A1 11/2006 Doradla et al.
2007/0026866 A1 2/2007 Krishnamurthi et al.
2007/0035513 A1 2/2007 Sherrard et al.
2007/0047547 A1 3/2007 Conner et al.
2007/0047697 A1 3/2007 Drewry et al.
2007/0060355 A1 3/2007 Amaitis et al.
2007/0060358 A1 3/2007 Amaitis et al.
2007/0076683 A1 4/2007 Chung et al.
2007/0082671 A1 4/2007 Feng et al.
2007/0086394 A1 4/2007 Yamada et al.
2007/0086401 A1 4/2007 Hong et al.
2007/0099703 A1 5/2007 Terebilo
2007/0197237 A1 8/2007 Powell et al.
2007/0202910 A1 8/2007 Brewer et al.
2007/0258415 A1 11/2007 Lu et al.
2007/0286111 A1 12/2007 Corson et al.
2008/0039015 A1 2/2008 Nakata et al.
2008/0052603 A1 2/2008 Wiatrowski et al.
2008/0069105 A1 3/2008 Costa et al.
2008/0082671 A1 4/2008 Meijer et al.
2008/0095112 A1 4/2008 Wiemann et al.
2008/0123608 A1 5/2008 Edge et al.
2008/0176561 A1 7/2008 Shao et al.
2008/0228547 A1 9/2008 Doss et al.
2009/0181728 A1 7/2009 Park
2009/0191878 A1 7/2009 Hedqvist et al.
2009/0222358 A1 9/2009 Bednarek
2009/0323648 A1 12/2009 Park et al.
2010/0093374 A1 4/2010 Dacosta
2010/0111066 A1 5/2010 Mehta
2010/0285776 A1 11/2010 de Froment
2011/0066369 A1 3/2011 Klassen et al.
2011/0066485 A1 3/2011 Rissanen
2011/0093876 A1 4/2011 Belz et al.
2011/0269431 A1 11/2011 Hardy et al.
2012/0095844 A1 4/2012 Barnes, Jr.
2012/0106728 A1 5/2012 Ghaffari et al.
2013/0096966 A1 4/2013 Barnes, Jr.

OTHER PUBLICATIONS

Newton, Harry: Newton's Telecom Dictionary: 15th Edition; Miller Freeman, Inc.; 1999; 3 pp.

"Universal Mobile Access: UMA Expands Beyond Dual-Mode Handsets"; The UMA Company; Jan. 200; 8 pages.

Meredith, John; "Voice Call Continuity in 3GPP"; CompactPCI and Advanced TCA Systems; Apr. 2006; 2 pages.

* cited by examiner

BEACON BASED PROXIMITY SERVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation of U.S. patent application Ser. No. 11/542,394 filed on Oct. 3, 2006, (now U.S. Pat. No. 8,411,662) which claims the benefit of U.S. Provisional Application No. 60/723,299, filed on Oct. 4, 2005. The entire disclosures of the applications referenced above are incorporated herein by reference.

FIELD

The present invention relates to wireless networks. More particularly, the present invention relates to the wireless communication protocol IEEE 802.11

BACKGROUND

It is well known that wireless devices such as telephones, email devices, and PDA's have been enabled for local wireless network communication with Internet protocol backbone networks by way of protocols such as the several forms of IEEE 802.11.

Alternately, automatic connection and communication systems may create a Personal-Area Networks (PAN). Other wireless standards that may be used include IRDA, hiperlan/2, and HomeRF. When a PAN is established, such as between one VoiP mobile phone and another, the members of the PAN can communicate directly. The more generally preferred mode of operation for such a mobile telephone is connection to a local access point, whereby the user can contact any source available to the Internet for conversation or gaming.

In a local area network communication, the access point transmits information separately to each local wireless device. An advantage to using a point-to-point communication is that different information (e.g., customization) may be sent to each wireless device. Even if the same information is being sent to several recipients (e.g., ensuring uniformity of a game's state for all local users coordinated by a remote server), however, in a point-to-point communication with multiple recipients, the information is transmitted redundantly to each recipient. However, an access point, comprising a wireless communication module and access point server which connects to an IP network, game state information may be transmitted, daisy chain, along point to-point communications from an access point within range of only one wireless device, thereby extending the effective communication range of the access point.

IEEE 802.11 protocols comprise negotiation-of-device or device-type negotiation using Information Elements. In a specific example, a server may send to a client a device-type inquiry, to which a device-type response is made by the client. These information elements carry only device information.

It is well known that vendor specific information can be carried in the information elements (IE's). However, information in IE's which is vendor specific cannot be used by wireless devices which are made by another vendor. In addition, information in IE's which is vendor specific cannot be used by applications available via the wireless network.

There is a need for a system which is uses information elements for additional purposes.

SUMMARY

The present invention relates to providing new capabilities for the IEEE 802.11 beacon.

In 802.11, data frames carry information from higher layers. However, management and control frames must be provided that support data transfer. The beacon frame is a type of management frame. A wireless local network requires these management frames for stations to establish and maintain communications.

A typical beacon frame is about fifty bytes long. It contains a common frame header and cyclic redundancy checking field, including others. The beacon also contains a service set identifier (SSID). The SSID identifies a specific wireless local area network. Before associating with said network, a wireless device must have the same SSID as the access point.

In ad hoc networks, the communication is point-to-point, not through access points. Thus, one of the wireless devices must take on responsibility for sending the beacon.

It is an object of the invention to provide application protocols for local wireless networks and personal area networks that provide for connection of one wireless device to another and thereafter having the wireless devices exchange capabilities. Capabilities of the devices are those known in the art. This mode of the invention may not work if the peer wireless devices do not or cannot associate at that time. For example, a wireless device enabled for IEEE 802.11 communication can only associate to one other wireless device at a time. Under that current protocol, it is impossible to connect to another network or system to determine capabilities beyond those in the devices beacon.

The IEEE 802.11 beacon is able to transmit a 32-character network identifier. This network identifier is only intended to carry the name of the network. Actual capabilities of the network are carried in other IE's. The invention system comprises additional uses for the SSID to include reliable and secure capability encoding. The SSID in the system can be controlled by applications and transmitted with periodic broadcasting or point to point communication, so interoperable communication of application or user preferences/capabilities/membership can be transmitted and quickly determined by peers.

BRIEF DESCRIPTION OF DRAWINGS

There are no drawing figures.

DESCRIPTION

The following are specific examples of the invention system.

The IEEE 802.11 beacon SSID is adapted to serve as a capabilities encoding channel.

For example, encoded capabilities and preferences are incorporated into the SSID to determine:

Group membership: such as invited members of a conference or game playing group.

User preferences:

Device capabilities:

System location:

Game state: such as a point of play in a computer game.

Encryption and security preferences:

Application software state: such as viewing a specific file.

The following are further examples of the invention system incorporating the use of SSID transmission of information:

Encoding of information where the information is encrypted.

Encoding of information: such as where information is integrity protected (checksum, secure hash, keyed hash, digital signature).

Encoding of information as a unique hash of capabilities.

Encoding as bit string with bits indicating capabilities.

Encoding where a bit string can have different encoding semantics based on receiver context.

Encoding used by peer mobile devices to alert user of proximity to another device.

Proximity used to indicate preferences of peer device user.

Proximity used as part of a game.

Encoding is encrypted to only allow access to information by approved peers.

Encoding is used as part of process to create encryption keys for subsequent communications.

After obtaining encoded SSID, device may use central server to assist in decoding.

Central server may return additional identity or location information.

Multiple different SSIDs can be used to define a single BSS.

Multiple different SSIDs can be used to define a single iBSS.

The above design options will sometimes present the skilled designer with considerable and wide ranges from which to choose appropriate apparatus and method modifications for the above examples. However, the objects of the present invention will still be obtained by that skilled designer applying such design options in an appropriate manner.

What is claimed is:

1. A first wireless device comprising:

a receiver configured to receive a beacon transmitted by a second wireless device, wherein the beacon includes a service set identifier, and wherein the service set identifier is encoded to include a capability of the second wireless device; and

a transmitter configured to transmit, to a server, the service set identifier received from the second wireless device,

wherein the service set identifier is decodable by the server to retrieve the capability of the second wireless device from the service set identifier, and

wherein the receiver is further configured to receive, from the server, the capability of the second wireless device subsequent to the server having decoded the service set identifier.

2. The first wireless device of claim **1**, wherein the first wireless device is configured to communicate with the second wireless device in accordance with the capability of the second wireless device received from the server.

3. The first wireless device of claim **1**, wherein the capability of the second wireless device encoded in the service set identifier comprises one or more of membership information, a user preference, a device capability, location information, an encryption and security preference, or a state of a software of the second wireless device.

4. The first wireless device of claim **1**, wherein the service set identifier in the beacon received by the receiver includes an indication of a proximity of the second wireless device to the first wireless device.

5. The first wireless device of claim **1**, wherein the capability of the second wireless device included in the service set identifier is based on a proximity of the second wireless device to the first wireless device.

6. The first wireless device of claim **1**, wherein the first wireless device is configured to:

generate an encryption key based on the service set identifier, and

communicate with the second wireless device using the encryption key.

7. The first wireless device of claim **1**, wherein the first wireless device communicates with the second wireless device via an ad-hoc network or an infrastructure network.

8. A method comprising:

receiving, at a first wireless device, a beacon transmitted by a second wireless device, wherein the beacon includes a service set identifier, and wherein the service set identifier is encoded to include a capability of the second wireless device; and

transmitting, from the first wireless device to a server, the service set identifier received from the second wireless device, wherein the service set identifier is decodable by the server to retrieve the capability of the second wireless device from the service set identifier; and

receiving, from the server, the capability of the second wireless device subsequent to the server having decoded the service set identifier.

9. The method of claim **8**, further comprising communicating with the second wireless device in accordance with the capability of the second wireless device received from the server by the first wireless device.

10. The method of claim **8**, wherein the capability encoded in the service set identifier comprises one or more of membership information, a user preference, a device capability, location information, an encryption and security preference, or a state of a software of the second wireless device.

11. The method of claim **8**, further comprising receiving, from the service set identifier in the beacon received by the first wireless device, an indication of a proximity of the second wireless device to the first wireless device.

12. The method of claim **8**, wherein the capability of the second wireless device included in the service set identifier is based on a proximity of the second wireless device to the first wireless device.

13. The method of claim **8**, further comprising, at the first wireless device:

generating an encryption key based on the service set identifier, and

communicating with the second wireless device using the encryption key.

14. The method of claim **8**, further comprising communicating with the second wireless device via an ad-hoc network or an infrastructure network.

* * * * *